



Submitted to the Federal Communications Commission, Washington, D.C.

**Response to Request for Comments on Rapidly Deployable Aerial Telecommunications
Architecture Capable of Providing Immediate Communications to Disaster Areas**

PS Docket No. 11-15 – DA 11-175, Released January 28, 2011

Comments of AeroVironment, Inc.

AeroVironment, Inc. (AV) submits these comments to the Commission regarding rapidly-deployable aerial telecommunications architectures capable of providing immediate communications to disaster areas. AV is a technology solutions-provider that designs, develops, produces, and supports an advanced portfolio of Unmanned Aircraft Systems (UAS) and electric transportation solutions. Agencies of the U.S. Department of Defense (DOD) and allied military services use AV's battery-powered, hand-launched UAS extensively to provide situational awareness to tactical operating units through real-time, airborne reconnaissance, surveillance, and communication. AV is also developing and testing High-Altitude, Long Endurance (HALE) platforms for strategic surveillance and communications-relay missions. More information about AV is available at <http://www.avinc.com>.

1 Introduction

We propose for consideration by the Federal Communications Commission (Commission) and the Public Safety and Homeland Security Bureau (Bureau) a set of unmanned aircraft solutions for rapidly establishing aerial communications architectures for public safety missions in the event of natural disasters, terrorist attacks, or other disruptive events. The first solution incorporates the use of hand-launched, battery-powered Small Unmanned Aerial Vehicles (SUAVs) that can be launched in minutes, fly below 500 ft Above Ground Level (AGL) and have the capability to immediately re-establish communications within a local area without the need of any additional infrastructure. The second solution focuses on the implementation of high-altitude, extreme-long-endurance unmanned aircraft for larger coverage areas. Both technology capabilities are currently fully operational (SUAVs) or at late stages of testing and evaluation (HALE aircraft).

2 Small Unmanned Aircraft Systems (SUAS)

AV manufactures a family of SUAS for a variety of missions. Our main product lines are the Wasp, Raven, and Puma AE air vehicles (see Figure 1). All air vehicles are operated from a common Ground Control Station (GCS). A system consisting of air vehicle, GCS, and batteries can fit inside a backpack or in the trunk of a car. All three vehicles are battery-powered, hand-launched, and can stay airborne for 45 minutes (Wasp), 90 minutes (Raven), and 2 hours (Puma AE). Longer missions can be accomplished by landing the vehicle, changing batteries, and launching again, a process that takes only a few minutes. Truly continuous coverage can be accomplished by using two air vehicles and overlapping their airborne time. Typical operating altitude is 300 to 500 ft AGL.

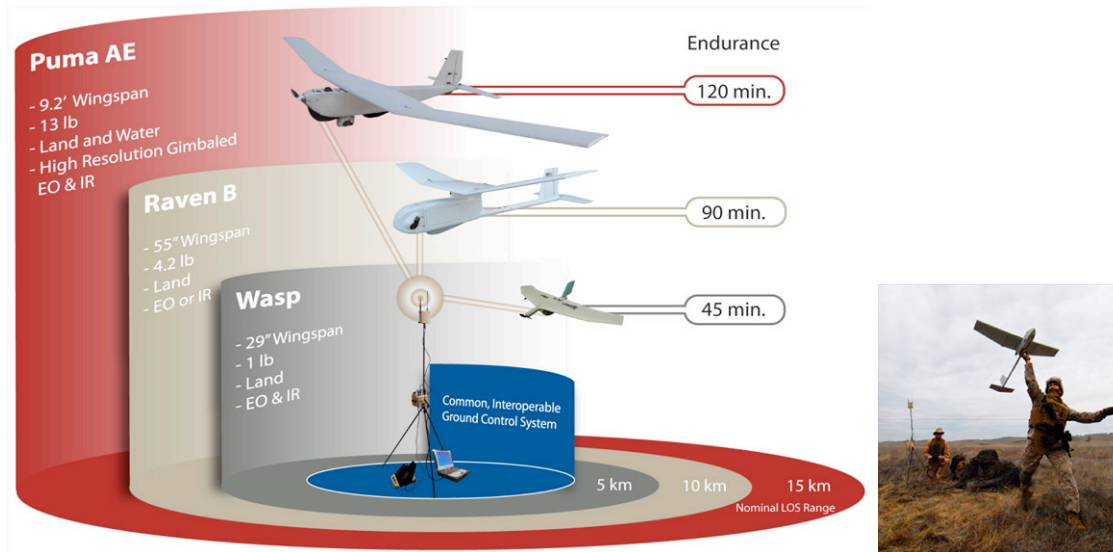


Figure 1: AV's Family of Small Unmanned Aircraft Systems Is Portable and Capable

We consider two ways in which SUAS can be employed for re-establishing communications during disruptive events: a) use of the datalink module that is used for command, control, and communications of the UAV system to create a secondary communications network using the system's RF frequencies, and b) use of repeaters and relay devices on separate frequencies for extending the range of existing communications systems by providing an "instant tower" through the use of an air vehicle flying at 500 ft above the area.

2.1 Use of Integrated Datalink Module for Communications Network

Our Raven and Puma AE systems incorporate AV's new communications module called Digital Data Link, or DDL (http://www.avinc.com/uas/small_uas/ddl/). AV's DDL system has been adopted by the U.S. Army as the standard communications architecture for all small unmanned aircraft systems, and it is being considered for control of all small unmanned systems, including ground robots. The DDL module is a single-frequency, encryptable, duplex transceiver that is used for command and control of the air vehicle (uplink) as well as video and telemetry data (downlink). In addition, DDL can be used to immediately create a communications network. For example, an air vehicle flying over an area can use its DDL transceiver to permit voice communications between literally hundreds of DDL-equipped mobile radios on the ground. In addition to voice, data and video can also be sent from one DDL ground module to another **through** the air vehicle, thus allowing non-line-of-sight communications between several ground units (see Figure 2, left side). The number of ground clients is only limited by the available bandwidth (typical bandwidth for our system is 5 MHz, but can be adjusted up or down).

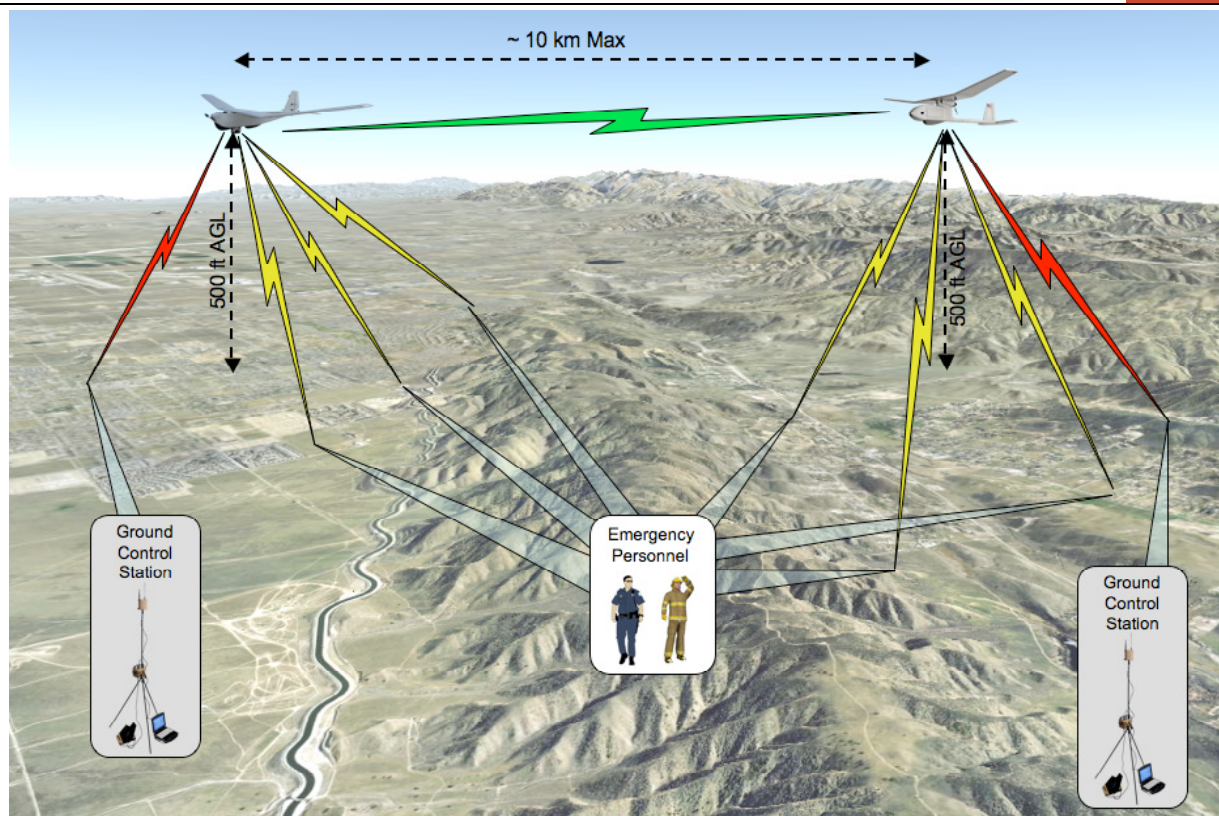


Figure 2: AV's Digital Data Link System Is Capable of Establishing an Immediate Secure Communications Network In Local Area or in Two Separated Areas Through Relay Operations

Another implementation of the DDL architecture enables the creation of a communications bridge between two areas that are farther away from each other than the normal area of operations of a single air vehicle. Also shown in Figure 2, one air vehicle can relay information from one set of ground modules to another other air vehicle, which can then disseminate that information to a second set of ground-based users. In either of the two implementations of DDL outlined above, real-time video information captured by the air vehicle is potentially available to any ground user in the DDL network, enabling coordinated surveillance and emergency support activities.

The capabilities identified so far are currently implemented in our line of Raven and Puma AE systems currently in full production – little or no development effort is needed to enable this type of communications architecture with the DDL system.

In order for the capability described thus far to be enabled, frequency spectrum will be needed for operation of the DDL system. To minimize the impact on existing communications and possibility of interference, spectrum used for DDL should be different than spectrum currently used for existing architectures (Land Mobile Radios for example). Our production DDL systems currently operate within the U.S. DOD military frequency spectrum. Inquiry should be made as to access to this spectrum by emergency response agencies during a calamitous event.



Another option is to assign different frequencies for this kind of operation. The options for currently-allocated Public Safety **broadband** spectrum are somewhat limited. Ideal spectrum for SUAS emergency communications missions would be in the 1.5 to 2.5 GHz range (or lower) to provide a good combination of propagation characteristics and consequently communications range.

The newly emerging 700 MHz Public Safety band is a possibility, although interference with Public Safety communications infrastructures currently being built on this band would need to be addressed.

Another option, the 4.9 GHz Public Safety band, is attractive because it encompasses a large bandwidth (50 MHz total). This band's propagation characteristics are not ideal – communications range is severely limited (compared to range at a lower frequency for the same power and antenna beam width). However, because the SUAS operations outlined here are generally direct line-of-sight, the 4.9 GHz band may be a workable option. Interference with existing 4.9 GHz infrastructure would have to be considered, as well as current restrictions on use of this band for airborne operations. On this latter issue, coordination of activities with nearby 4.9 GHz users and Radio Astronomy sites would be needed. The low altitude that SUAS operate at (less than 500 ft above ground) may facilitate addressing of airborne restrictions.

2.2 Use of Repeaters to Re-Establish Communications

Another option for a telecommunications architecture is to use SUAS to carry repeaters or relay devices for traditional land mobile radio systems in the event of emergencies. The repeaters carried by the UAVs can either augment or replace existing telecommunications architectures by providing a radio node that has superior line of sight properties (an instant “repeater tower”). The repeater architecture allows existing land mobile radios (including cellular telephone and those operating in UHF and VHF) to be used. Range and throughput of this type of system would depend highly on the capabilities of the repeaters that can be carried by the air vehicles. Devices in the range of 0.5 pounds to 2 pounds can be considered for Raven and Puma AE air vehicles respectively. Frequency coordination when using repeaters would need to be addressed to ensure that the larger field of influence of an airborne repeater does not affect nearby telecommunications infrastructures.

Frequency spectrum for command, control, and communications between the air vehicle and its Ground Control Station would still be needed. This can be accomplished through the options described in the previous section. If video data from the air vehicle is not needed, bandwidth requirements are reduced, thus opening more options for frequency spectrum for air vehicle use.

2.3 Regulatory Issues Affecting Airspace for SUAS

Operation of SUAS in non-restricted airspace are currently limited by the FAA. Public agencies can operate UAS by obtaining a Certificate of Authorization from the FAA. Operations under a COA have up to now been limited to visual line of sight (less than 1 mile between air vehicle and Ground Control Station) and less than 500 ft AGL. These restrictions do not restrict the telecommunications missions indicated above. There are a number of efforts currently in progress to allow SUAS more open access to non-restricted airspace. It is expected that the FAA

will enact new regulations that govern SUAS operations by 2014-2015. It is also likely that public agencies will be able to conduct SUAS operations more freely earlier than this date. There are some indications as well that the FAA may allow special considerations for Public Safety SUAS operations in emergency situations.

Another consideration for airspace integration is the use of Temporary Flight Restrictions (TFRs), which can be set up in emergencies. A TFR over an area where telecommunications need to be re-established may allow operation of SUAS without the need for a COA. AV can provide additional information to the Commission upon request regarding the current landscape of airspace regulations as they affect SUAS employed in Public Safety and emergency telecommunications missions.

3 High Altitude Long Endurance (HALE) Aircraft

We also propose for consideration of the Commission the use of High Altitude Long Endurance (HALE) systems for re-establishing communications architectures over large areas. AV is recognized as the world leader in the development of HALE unmanned aircraft and associated systems. Our aircraft have broken many world records, including the world's record for altitude of 96,000 ft, higher than any other non-rocket-powered aircraft. The Global Observer UAS is the culmination of decades of research and development in this area. This state-of-the-art system is currently undergoing advanced flight testing using liquid hydrogen as its energy source (Figure 3). Coupled with a highly efficient hydrogen-powered-engine and custom-designed motor drive systems, Global Observer (GO) is capable of flights up to 7 days (continuous) at altitudes above 50,000 ft.



Figure 3: Global Observer (GO) Currently Undergoing Advanced Flight Testing at Edwards Air Force Base

With a payload capacity of 400 pounds, GO can eliminate current and future communication architecture “gaps and seams”. Existing communications systems that can be carried are capable of providing high bandwidth (i.e. multi-Gigabit per second total throughput) to an area up to 600 miles in diameter. The GO UAS currently undergoing flight testing carries an existing communications relay payload that is capable of providing the interconnectivity required by the Commission for emergency telecommunications architectures (Figure 4). Key features of this communications relay payload include range extension for voice and tactical data communications, bridges and relays for radio communications via VoIP/RoIP, and conference IP phones to field radio users. Additional information regarding capabilities of this and other telecommunications payloads is available for presentation to the Commission upon request.



Figure 4: Global Observer Enables Telecommunications Missions for Emergencies and Natural Disasters for up to 7 Days (http://www.avinc.com/globalobserver/missions/disaster_relief)

The extreme endurance of the GO UAS results in a very low operational tempo and low operational costs with a minimum logistics tail. This ensures an affordable system in the operations phase, especially when compared with conventional airborne (manned and unmanned) systems with relatively low endurance (1-2 days). For normal operations the aircraft, ground support systems, and operations can be easily conducted from a site with a normal runway (150 ft X 5500 ft). Hydrogen generation and liquefaction systems are commercially available for on site production of liquid hydrogen, or liquid hydrogen can be easily shipped to most locations in the world. (Over 9 million tons of hydrogen are produced per year just in the U.S. alone).

4 Additional Information

For additional information on the technologies and capabilities discussed here, please contact Gabriel Torres (contact information below).

Respectfully submitted



Gabriel Torres, Ph.D.
AeroVironment, Inc.
900 Enchanted Way, Simi Valley, CA 93065
Phone: (805) 581-2187 x1427
Email: torres@avinc.com
Web: <http://www.avinc.com>

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